OIPE JC104 JUN 13 2005 PATENT & TRADEMARK OFFICE

IFW

45047 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	:	
Wu Zhangyi et al.	:	Group Art Unit: 2731
Serial No.: 10/617,363	:	Examiner: Vu, Huy Duy
Filed: July 11, 2003	:	
For: Apparatus and Method for Transmitting DS3 Signal Using Twisted Pairs	:	

REQUEST FOR RECONSIDERATION

Mail Stop Petitions
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is a request for reconsideration of the petition to make special filed on March 17, 2005, which was denied in the decision mailed on April 13, 2005.

The petitioner based the request to make special on the fact that the petitioner's invention conserved energy by reducing the need to use trucks, excavation equipment, such as backhoes and front loaders, all of which operate by using either a gasoline or diesel combustion engine or system.

The Special Program Examiner based his denial of the petition on the fact that the Petitioner has not shown how the reduction in the need for fiber optics corresponds to reduced energy consumption.

Attached to this petition is a statement with additional facts by the applicant's attorney, Martin E. Miller, explaining how the invention materially contributes to reducing energy consumption in industrial equipment. This is understood to constitute adequate grounds for granting the petition under 37 C.F.R. §1.102. A petition fee is not required per 37 C.F.R. §1.102(c). Early and favorable reconsideration of this petition is respectfully requested.

Respectfully submitted,

Martin E. Miller
Reg. No. 56,022

Roylance, Abrams, Berdo & Goodman, L.L.P.
1300 19th Street N.W., Suite 600
Washington, D.C. 20036
(202) 659-9076

Dated: June 13, 2005

Statement of Martin E. Miller

The present invention is directed to using existing infrastructure to provide high speed data to user's premises in a cost effective and efficient manner as was outlined in the statement initially provided with the petition to make special mailed on March 17, 2005.

Attached is an article entitled, "Cities Get Up To Speed", which appeared in Government Enterprise magazine, dated September, 6, 2004, by Eileen Cuneo, which outlines the benefits and the hardships that various city governments have encountered when providing high speed data over fiber optic cables.

The Special Program Examiner's attention is directed to the seventh paragraph where the City of Richardson, Texas is discussed. In particular, Ms. Cuneo states that trenches must be dug to run the fiber optic cable and that the cost of digging trenches and other installation costs would have cost the city $4.5 million.

A portion of the $4.5 million would have to have been spent on fuel for the excavation equipment, such as shovels, used to dig the miles of trenches. Companies that provide these types of excavating serves have methods of estimating the cost of fuel for a project. A company that provides estimating services to construction companies is the Frank R. Walker Company of Lisle, Illinios. Attached is an excerpt of the chapter entitled, "SITE WORK", from 26th Edition of Walker's Building Estimators Book, which was obtained from www.frankrwalker.com, in which the calculation for the amount of fuel to be used for a particular project is shown at pages 2.37 and 2.38. Besides providing the calculation for the amount of gallons or liters per hour that are used, the excerpt also states that shovels "normally consume a greater amount of fuel than other types of machines".

Finally, attached is an product description of the Caterpillar 420D Backhoe Loaders, (obtained at www.yanceybcp.com/backhoe.htm), which is similar to the excavating equipment shown in the previously provided statement mailed on March 17, 2005. Using the net horsepower of 85 provided for the Caterpillar 420D backhoe, in the formula shown in the Walker text, it was calculated that the 420D at a 50% use factor would use approximately 2.91 gallons of diesel fuel per hour.

By not having to use the excavating equipment to dig trenches for the installation of fiber optic cables, the present invention has a direct effect on reducing energy consumption by eliminating the need for fiber optic cables and their installation and therefore the reason for having to consume thousands of gallons of fuel to dig miles of trenches.

The above statements combined with the statement previously provided shows that the invention materially contributes to the conservation of energy resources by eliminating the need for having to use the resource.

Martin E. Miller
Reg. No. : 56,022

ENTERPRISE

IT INNOVATION IN THE PUBLIC SECTOR

Cities Get Up To Speed

By Eileen Colkin Cuneo , Government Enterprise
Sep 06, 2004 (03:01 PM)
URL: http://www.governmententerprise.com/showArticle.jhtml?articleID=29116663

City officials in Milwaukee proudly revealed two years ago that they had completed a citywide state-of-the-art broadband network that connected 50 municipal facilities. The city used duct lines that were buried in the 1800s to carry telegraph wires, installed optical fibers and optical Ethernet switches, and became one of the first cities to have its own high-speed private communications network.

Today, the network is the backbone for Milwaukee's city services, including fire and police communications. Among the services on the network: a single alarm system to protect all city buildings and a system to monitor fuel consumption that gathers data from gas stations used by city vehicles. "We can carry anything across our network," says Gerard Froh, network planning manager in the city's Department of Public Works Administration.

Milwaukee has accomplished what many cities only dreamed about in the late 1990s: It built a fiber network to create a high-tech mecca to attract businesses. Many other municipalities weren't able to implement plans for such networks. But a few cities are building high-speed networks or have already done so.

Attracting new businesses and jobs is always a factor in municipal infrastructure improvements. But the realities of a recession-ridden, post-9/11 world have changed the rationale behind many projects. For Milwaukee, as well as Cleveland, Richardson, Texas, and Washington, D.C., reliability, improved efficiency, better quality of service, disaster-recovery capabilities, and cost savings are among the top reasons for building their own high-speed networks.

Washington, D.C.'s Roy sold budget setters on a broadband network by showing how it would save money.

Photo by David Deal

In the nation's capital, saving money was a big impetus for a broadband network that will wire together 300 buildings--at least it was the main driver that "sells" to government budget setters, says Peter Roy, deputy director of the city's office of the chief technology officer. In developing a business plan for DCnet, Roy discovered the city was paying the local phone company, Verizon, $30 million annually for a variety of voice and data services, not including wireless.

DCnet is based on a 2.488-Gbps OC-48 backbone and uses optical-networking gear from Cisco Systems. It will save the city $10 million a year in carrier fees, while providing additional savings by permitting centralized management and help-desk services for computer users across agencies. Since the project started at the beginning of the year, Roy has run fiber to 200 buildings. The first 20 buildings connected house 80% of DCnet's subscribers. "By the time we have [those] 20 buildings done, we'll be in the black," Roy says.

Building a municipal network isn't easy or cheap, city officials say. Installing fiber throughout a city requires digging lots of trenches, which can be expensive. Steve Graves, CIO of Richardson, Texas, had to shelve for seven years his plan to run 38 miles of fiber to the city's 17 main facilities because of its $4.5 million cost. But running the Dallas suburb on 15 congested 1.5-Mbps T1 lines that cost $300 a month

each and were difficult to maintain prompted Graves to look for a partner. He found one in the local school district. "Going with the school dropped our costs to $1.9 million, which is expensive," Graves says. "But we've now got 10 times the speed and capability in our network--and it's ours."

Joint efforts and partnerships make broadband networks affordable for some communities, says Rob Keats, director of optical marketing at Nortel Networks Ltd. "The most successful project leaders are ones that have brought in the local school board, utility, and emergency services," Keats says. The Los Angeles Department of Water and Power, for example, built an extensive network across the L.A. area and has made it available to other local departments and businesses; it also sells excess bandwidth to service providers.

There are other benefits. In addition to data speeds of up to 1 Gbps per site, the now-completed Richardson network gives Graves the reliability he wants. The fiber network was built in a ring to connect primary sites such as the fire department and City Hall using Nortel's Passport 8600 Routing Switches, which provide split-second failover in case of a network problem. That came in handy in August. "A contractor was digging up the sewer line and hit part of the fiber," Graves says. "The system switched over so fast we didn't even know about it until they told us."

Such reliability is critical as the need for secure communications becomes more important. In Washington, Roy uses carrier-grade equipment; a resilient, self-healing packet ring from Cisco; two connections linking DCnet to the public phone network; and redundant operations centers. He also has generators that can keep communications flowing in an outage--a requirement service providers couldn't satisfy.

Once a municipal network is in place, cities can find many uses for it. Milwaukee plans to connect stoplights to change timing and control traffic flow around accidents or construction.

OneCleveland's broadband network will aid economic development, Scot Rourke says.

In Cleveland, a nonprofit group that includes universities, hospitals, and the city government is focused on bringing the community together through broadband. "Our long-term goal is to transform the region and use the network as an economic development engine that will ultimately lead to wealth development," says Scot Rourke, executive director of the agency, called OneCleveland.

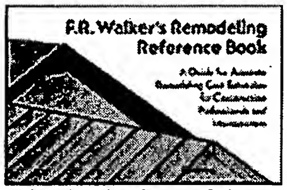
In August, Case Western Reserve University and Cleveland turned on their own fiber-optic ring networks; the next step is to link the two. The plan is to expand the networks and offer access to entities around the city. Rourke says hospitals can use the network to share data or 3-D MRIs, universities can offer online curricula, and commuter trains can offer wireless Internet access. These efforts are aimed at making Cleveland a better place to live, work, and back up your data.

Building a network is just the beginning, however. "Once you have your own fiber-optic network," says Washington's Roy, "you can use that to change your approach to all the technologies attached."

Network building is an expensive undertaking for a city. But in the long run, it can provide a foundation for offering a host of new services to residents, as well as cutting costs and improving the efficiency of city services. Whether the politicians who control the purse strings agree will determine if more municipal networks are built.

[HOME](#)
[Estimating](#)
[Bookstore](#)
[Forms](#)
[Measuring Instruments](#)
[Calculators](#)
[Scales](#)
[About Us](#)
[Links](#)
[Customer Service](#)
[Email Us](#)

Get a Free Catalog of Walker Books and Forms

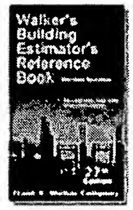


Take the devil out of the details with **F.R. Walker's Remodeling Reference Book**

FRANK R. WALKER COMPANY estimating resources & construction store

---

Ensure profits with the trusted source ...
Introducing our NEW 27th Edition!



Walker's Building Estimator's Reference Book

Find out why generations of contractors have relied on **Walker's Building Estimator's Reference Book** to maximize profits. In print since 1915, it equals an entire library of construction estimating books.

Order the **NEW 27th Edition**

Click here to read excerpts from the previous edition.

Would you like us to eMail you when we update www.FrankRWalker.com?

Your eMail address: Watch this site for me

Frank R. Walker Company
P.O. Box 3180, Lisle, IL 60532

Send an email
Phone: 1-800-458-3737

Website produced by: BuildingOnline
The Building Industry's Web Design and Marketing Agency.

On medium to large grading jobs, self-propelled or tractor-hauled scrapers are used quite often and perform cutting and filling operations very creditably.

Quantities and production times given in the tables below are average. Experienced excavators will perform more work than given, but an inexperienced worker will perform less, so average conditions have been used.

Hydraulic power excavating equipment has become very extensive. For the most part, hydraulic-operated excavating equipment has replaced the old cable-operated machines and is used almost 100 percent on the smaller excavation machines.

HAND EXCAVATION

Most construction projects require extensive use of hand labor to accomplish the selective types of excavation which cannot be performed by machine excavators.

In the excavation of footings, it is frequently found to be cost effective to combine the use of machines for the bulk excavation and then to "hand dress" the bottoms, sides, and corners to produce the precise horizontal and vertical planes required. Similarly, this is true in finalizing the subgrade elevation under slabs on grade, walks, and patio slabs.

The quantities and production rates given in the following table are for average conditions.

Material & Operation	Avg. No. Cu. Yd. per 8 Hr Day	Manhours per Cu. Yd.	Avg. No. Cu. M 8 Hr Day	Manhours per Cu. M
Sandy loam				
Small footings, hand	6	1.33	4.60	1.33
Trenches 3' 4' (.9 1.2 m) deep, hand	6	1.33	4.60	1.33
Piers 6' (1.8 m) deep, hand 1 lift	5	1.60	3.80	1.60
Piers 12' (3.7 m) deep, hand 2 lifts	3	2.66	2.30	2.66
Heavy soil and clay				
Small footings, hand	5	1.60	3.80	1.60
Trenches 3' 4' (.9 1.2 m) deep, hand	5	1.60	3.80	1.60
Piers 6' (1.8 m) deep, hand, 1 lift	4	2.00	3.00	2.00
Piers 12' (3.7 m) deep, hand, 2 lifts	2	4.00	1.50	4.00
Excavation with ½-cu.yd. (.40 cu. m) backhoe, casting to side				
Trench footing	300	--	230	--
Pier footing 6' (1.8 m) deep	200	--	153	--
Pier footing 12' (3.7 m) deep	150	--	115	--

Hand Trimming Trench, Piers And Slabs After Machine Excavation

Area	SF per 8-Hr Day	SF per Hour	Sq. M per 8-Hr Day	Sq. M per Hour
Bottom and side areas	240	30	22.40	2.80
Fine grade under slabs	600	75	56.00	7.00

Backfilling By Hand With Compaction Material From Stockpile

Ordinary Light Soils	Cu. Yd. per 8-Hr Day	Manhours per Cu. Yd.	Cu. M per per 8-Hr Day	Manhours per Cu. M
Soil distribution laborer	12	0.67	9.20	0.90
Compactor operator	12	0.67	9.20	0.90

No allowance for compactor equipment cost.

MACHINE EXPLORATION

Excavating Using a 1 Cu. Yd. (.76 Cu. M) Tractor Shovel

Class of Work	Avg. No. Cu. Yds. per 8-Hr Day	Tractor & Operator Hours per 100 Cu. Yds.	Avg. No Cu. M per 8-Hr Day	Tractor & Operator Hours per 76 Cu. M
Excavating ordinary soil and placing in piles on premises	325-375	2.30	250 290	2.30
Excavating heavy soil and clay and placing in piles on premises	250 300	2.90	190 230	2.90
Loading loose sand or gravel into trucks	400 450	1.90	305 345	1.90
Excavating ordinary soil and loading into trucks	400 450	1.90	305 345	1.90
Excavating heavy soil and clay and loading into trucks	300 350	2.50	230 270	2.50
Backfilling loose earth Bulldozing	500 600	1.45	380 460	1.45

The above table is based upon a 50-foot haul from excavation to dump. For each additional 50 feet in length of haul, add 1-1/2 to 2 hrs. tractor time per 100 cu. yds. or consider the use of trucks.

Excavating Using a 2-1/4 Cu. Yd. (1.70 Cu. M) Tractor Shovel

Class of Work	Avg. No. Cu. Yds. per 8-Hr Day	Tractor & Operator Hours per 100 Cu. Yds.	Avg. No. Cu. M per 8-Hr Day	Tractor & Operator Hours per 76.0 Cu. M
Excavating ordinary soil and placing in piles on premises	600 650	1.30	460 500	1.30

Excavating heavy soil and clay and placing in piles on premises	450 500	1.70	345 380	1.70
Loading loose sand or gravel into trucks	775 825	1.00	595 630	1.00
Excavating ordinary soil and loading into trucks	775 825	1.00	595 630	1.00
Excavating heavy soil and clay and loading into trucks	575 625	1.35	440 480	1.35
Backfilling loose earth bulldozing	925-975	0.85	710-745	0.85

The above table is based upon a 50-foot haul from excavation to dump. For each additional 50 feet in length of haul, add 3/4 to 1 hr. tractor time per 100 cu. yds. or consider the use of trucks.

Excavating Using Hydraulic Tractor (Crawler) Backhoe 1 Cu. Yd. (.76 Cu. M) Bucket

Type of Material	Avg. No. Cu. Yds. per 8-Hr Day	Backhoe & Operator Hours per 100 Cu. Yds.	Avg. No. Cu. M per 8-Hr Day	Backhoe & Operator Hours per 76.0 Cu. M
Sandy Clay/Moist Loam	720	1.10	550	1.10
Gravel/Sand	690	1.20	530	1.20
Clay, Hard	570	1.40	435	1.40
Rock				
Well Blasted	450	1.80	345	1.80
Poorly Blasted	300	2.70	230	2.70

Above production is based on the following: project conditions, average to above average; operator, average; obstructions, none; swing, to 60 degrees or 1/4 turn.

Excavating Using Hydraulic Tractor (Crawler) Backhoe 1/4-Cu. Yd. (.20 Cu. M) Bucket

Type of Material	Avg. No. Cu. Yds. per 8-Hr Day	Backhoe & Operator Hours per 100 Cu. Yds.	Avg. No. Cu. M per 8-Hr Day	Backhoe & Operator Hours per 76.0 Cu. M
Sandy Clay/Moist Loam	900	0.90	690	0.90
Gravel/Sand	840	0.95	640	0.95
Clay, Hard	570	1.40	435	1.40
Rock				
Well Blasted	450	1.80	344	1.80
Poorly Blasted	300	2.70	230	2.70

Above production is based on the following: project conditions, average to above average; operator, average; obstructions, none; swing, to 60 degrees or 1/4 turn.

Excavating Using Hydraulic Tractor (Crawler) Backhoe
1-1/2 Cu. Yd. (1.15 Cu. M) Bucket

Type of Material	Avg. No. Cu. Yds. per 8-Hr Day	Backhoe & Operator Hours per 100 Cu. Yds.	Avg. No. Cu. M per 8-Hr Day	Backhoe & Operator Hours per 76.0 Cu. M
Sandy Clay/Moist Loam	1080	0.75	825	0.75
Gravel/Sand	1020	0.80	780	0.80
Clay, Hard	870	0.90	665	0.90
Rock				
Well Blasted	660	1.20	505	1.20
Poorly Blasted	420	1.90	320	1.90

Above production is based on the following: project conditions, average to above average; operator, average; obstructions, none; swing, to 60 degrees or 1/4 turn.

Excavating Using Hydraulic Tractor (Crawler) Backhoe
1-3/4 Cu. Yd. (1.34 Cu. M) Bucket

Type of Material	Avg. No. Cu. Yds. per 8-Hr Day	Backhoe & Operator Hours per 100 Cu. Yds.	Avg. No. Cu. M per 8-Hr Day	Backhoe & Operator Hours per 76.0 Cu. M
Sandy Clay/Moist Loam	1260	0.60	965	0.60
Gravel/Sand	1200	0.70	915	0.70
Clay, Hard	1020	0.80	780	0.80
Rock				
Well Blasted	750	1.05	575	1.05
Poorly Blasted	510	1.60	390	1.60

Above production is based on the following: project conditions, average to above average; operator, average; obstructions, none; swing, to 60 degrees or 1/4 turn.

Excavating Using Hydraulic Tractor (Crawler) Backhoe
2 Cu. Yd. (1.52 Cu. M) Bucket

Type of Material	Avg. No. Cu. Yds. per 8-Hr Day	Backhoe & Operator Hours per 100 cu. yds.	Avg. No. Cu. M per 8-Hr Day	Backhoe & Operator Hours per 76.0 cu.m
Sandy Clay/Moist Loam	1440	0.55	1100	0.55
Gravel/Sand	1380	0.60	1055	0.60
Clay, Hard	1140	0.70	871	0.70
Rock				
Well Blasted	870	0.90	665	0.90
Poorly Blasted	720	1.10	550	1.10

Above production is based on the following: project conditions, average to above average; operator, average; obstructions, none; swing, to 60 degrees or 1/4 turn.

Excavating Using Hydraulic Tractor (Crawler) Backhoe
3 Cu. Yd. (2.30 Cu. M) Bucket

Type of Material	Avg. No. Cu. Yds. per 8-Hr Day	Backhoe & Operator Hours per 100 cu. yds.	Avg. No. Cu. M per 8-Hr Day	Backhoe & Operator Hours per 76.0 cu.m
Sandy Clay/Moist Loam	1800	0.45	1376	0.45
Gravel/Sand	1710	0.45	1307	0.45
Clay, Hard	1440	0.55	1100	0.55
Rock				
Well Blasted	1080	0.75	825	0.75
Poorly Blasted	720	1.10	550	1.10

Above production is based on the following: project conditions, average to above average; operator, average; obstructions, none; swing, to 60 degrees or 1/4 turn.

ESTIMATING THE COST OF OWNING AND OPERATING CONSTRUCTION EQUIPMENT

The following information on the costs of owning and operating power shovels, hoes, cranes, truck cranes, tractors, and scrapers will give a general idea of the costs involved in making up an estimate for this type of work.

The equipment purchase prices given are only a relative guideline to be used in the tables. What is most importance is the format for determining these costs, not the price of the equipment listed, which will vary greatly depending on locality, method of purchase, number of pieces bought at one time, etc.

The price f.o.b. factory should cover the complete machine with all variable equipment and accessories, such as various attachments, light plant, magnet generators, and clamshell bucket.

Total Investment or Cost of Equipment. Depreciation, interest, taxes, and insurance are directly related to the initial investment in construction equipment. In addition, certain other costs may be estimated by their normal relationship to this figure. Therefore, the proper determination of the total cost is a basic requirement.

Approximate Prices of Power Shovels, Draglines,
Clamshells, and Lift Cranes

The following are approximate prices, f.o.b. factory, and will give the estimator some idea of the investment required in shovels and cranes of various sizes:

Power Shovel
Crawler

Size of Shovel	
3/4 cu. yd (0.57 cu. m)	$100,100.00
1 cu. yd (0.75 cu. m)	105,600.00
1-1/2 cu. yd (1.15 cu. m)	160,600.00
2 cu. yd (1.50 cu. m)	341,000.00
3-1/4 cu. yd (2.50 cu. m)	631,400.00
4-1/4 cu. yd (3.25 cu. m)	740,000.00
5-1/2 cu. yd (4.20 cu. m)	880,000.00
6 cu. yd (4.60 cu. m)	1,050,000.00

Backhoe Crawler

Bucket Size of Hoe	
3/4 cu. yd. (0.57 cu. m)	$125,400.00
1 cu yd. (0.75 cu. m)	165,000.00
1-1/4 cu. yd. (0.95 cu. m)	170,500.00
1-1/2 cu. yd. (1.15 cu. m)	258,500.00
2 cu. yd. (1.50 cu. m)	298,100.00
2-1/2 cu. yd. (1.90 cu. m)	440,000.00
4-1/2 cu. yd. (3.45 cu. m)	1,020,000.00

Dragline Excavators Including a Medium Duty Bucket

Size of Dragline	
1/2 cu. yd (0.38 cu. m)	$89,100.00
3/4 cu. yd (0.57 cu. m)	99,000.00
1 cu. yd (0.75 cu. m)	145,200.00
1-1/4 cu. yd (0.95 cu. m)	292,500.00
2-1/2 cu. yd (1.90 cu. m)	517,000.00
3 cu. yd (2.30 cu. m)	640,200.00
3-1/2 cu. yd (2.67 cu. m)	770,000.00

Clamshell Excavators Including a Medium Duty Bucket

Size of Clamshell	
1/2 cu. yd (0.38 cu. m)	$88,000.00
3/4 cu. yd (0.57 cu. m)	99,000.00
1 cu. yd (0.75 cu. m)	145,200.00
1-1/4 cu. yd (0.95 cu. m)	288,200.00
2-1/2 cu. yd (1.90 cu. m)	517,000.00
3 cu. yd (2.30 cu. m)	640,200.00
3-1/2 cu. yd (2.67 cu. m)	770,000.00

Lift Cranes - Crawler Mounted

Capacity Tons	Kips	Kg (kilograms)	Cost
15	30	13,600	$165,000.00
20	40	18,145	203,500.00
30	60	27,215	216,700.00
40	80	36,290	231,000.00
45	90		271,700.00
50	100	45,360	302,500.00
70	140	63,500	418,000.00
100	200	90,720	597,300.00
150	300	136,080	715,000.00
200	400	181,400	880,000.00
400	800	362,880	1,320,000.00

Approximate Rental Costs For Excavating Equipment With Operator

Type	Size Cu. Yds.	Cu. M	Day	Week	Month
Crawler Mounted Backhoe	1/2	0.38	$453	$1,020	$6,770
	1	0.75	600	2,240	8,000
	2	1.50	1,020	3,700	12,500
	2-1/2	1.90	1,300	4,600	15,300
Compactor (with operator)	1000# Ram	454 kg Ram	57	275	980
	1000# Vib	454 kg Vib	47	195	915
	5000# Vib	2,268 kg Vib	220	915	3,400
	2000# Drum	907 kg Drum	100	430	1,950
Crane-Cable Crawler (with operator plus oiler)					
	30 T 60 Kips	27,215 kg	600	2,660	9,310
	40 T 80 Kips	36,290 kg	660	2,920	10,100
	60 T 120 Kips	54,430 kg	880	3,800	12,780
	100 T 200 Kips	90,720 kg	1,060	4,570	15,100
	150 T 300 Kips	136,080 kg	1,170	6,000	19,450
Crane-Cable Truck (with operator plus oiler)					
	40 T 80 Kips	36,290 kg	790	3,260	10,950
	60 T 120 Kips	54,430 kg	840	3,440	11,500
	80 T 160 Kips	72,575 kg	1,080	4,350	14,150
	100 T 200 Kips	90,720 kg	1,260	5,100	16,300
Crane-Hydraulic Truck (with operator plus oiler)					
	15 T 30 Kips	13,610 kg	500	2,170	7,440
	30 T 60 Kips	27,215 kg	740	3,130	10,740
	60 T 120 Kips	54,430 kg	1,140	4,790	15,600
Drill (with laborer)	(light)35 lb rock	18 kg	25	75	200
	(medium) 65 lb rock	30 kg	30	85	240
	(heavy) 90 lb rock	40 kg	40	95	300
Scraper (with operator)	11 cy	8.40 cu. m	500	2,250	9,000
	22 cy	16.8 cu. m	850	3,900	15,800
Tractor - Dozer (with operator)	105 hp	78 kw	400	1,900	7,600
	180 hp	134 kw	450	2,100	8,600
Loader (with operator)	1-1/2 cy	1.15 cu. m	400	1,900	7,600
	2-1/4 cy	1.70 cu. m	480	2,300	9,100

Type	Cu. Yds.	Cu. M	Day	Week	Month
Trencher (with operator)	16 cy	12.25 cu. m	330	1,400	4,500
	24 cy	18.34 cu. m	400	1,600	5,800

The above costs do not include move charges or permits, and they do not include fuel or other daily operating expenses.

Basic Power Shovel Unit and Front End Attachments. Naturally, the ideal situation would be to have the most suitable and economical power shovel, backhoe, crane, or dragline for each job, but this is seldom practical or profitable. More frequently, the contractor must take into consideration the handling of a wide range of work with varying conditions, requiring more or less frequent and easy conversion (for example, shovel to dragline or crane to clamshell) by simply changing attachments on the basic unit.

Power cranes and shovels are designed to accommodate a wide range of front-end attachments and working tools to meet the various job requirements. The attachments are classified into three basic groups: the shovel boom, the crane boom, and the hoe boom. These attachments generally are interchangeable in the field.

Since the basic purpose of the shovel boom is for shovel work and the hoe boom for hoe work, the crane-type boom serves for all other materials handling tools, such as dragline buckets, clamshell buckets, orange peel buckets, hooks, hook blocks, tongs, grabs, clamps, grapples, concrete buckets, skull crackers, and pile driving leads.

Crane type booms can be extended for extremely high lifts by inserting standard sections in the center of the boom and by boom tip extensions called jibs. These jibs are used primarily to extend horizontal reach with boom raised vertically close to maximum elevation. They also provide an increase in vertical lifting range. Since the jib adds weight at the outer lifting radius and extends the working range, it has a limiting effect on lifting capacity.

Average Useful Life of Power Shovels, Hoes, and Cranes. A reasonable allowance for the exhaustion, wear, and tear of property used in business, including a reasonable allowance for obsolescence, is permitted in figuring depreciation on your equipment.

Average Useful Life of Power Shovels and Hoes

3/8 3/4 cu. yds. (.28-.57 cu. m)	5 years or 10,000 hours
1 1-1/2 cu. yds. (.76-1.15 cu. m)	6 years or 12,000 hours
2 cu. yds. and over (1.53 cu. m and over)	8 years or 16,000 hours

Average Useful Life of Draglines, Clamshells and Cranes

	Tons	Years	Hours
3/8 3/4 c.y (0.28-0.57 cu.m)	2-1/2 5	5	10,000
1 1-1/2 c.y. (0.76-1.15 cu.m)	10-15	9	18,000
2 c.y (1.52 cu.m) and over	20 and over	12	24,000

The grouping shown for lifting cranes is a separate grouping and does not necessarily relate to the machines by size in cu. yds. For example, many 3/4 cu. yd. excavators (clamshell or dragline) would have a greater rating than 5 tons and might be rated in tons to fall in a different group than they do as excavators.

Depreciation. The straight line method of figuring depreciation is used. This method is in general adequate, but if it is desired to take changing prices for equipment into account in estimating, an annual appraisal to determine a current value should be considered.

Therefore, for the years and hours used, the following percentage of depreciation for the various groups are used:

Years	Hours	% per Year	% per Hour
5	10,000	20.00%	0.01%
6	12,000	16.67%	0.00833%
8	16,000	12.50%	0.00625%
9	18,000	11.11%	0.00555%
10	20,000	10.00%	0.005%
12	24,000	8.33%	0.00416%

Interest, Taxes and Insurance. Interest, taxes, insurance, and storage are usually charged at 20% of the average investment, of which 15% is interest (to be adjusted for current rates) and 5% covers taxes, insurance, storage, and incidentals.

Average investment must be established, based on the number of years used for depreciation. Since the first year is considered as 100% and since the investment is considered at the beginning of each year, the method of calculating average investment for a 5-year depreciation period is as follows:

1st year	100% of total investment
2nd year	80% of total investment
3rd year	60% of total investment
4th year	40% of total investment
5th year	20% of total investment
	300% of total investment

Average investment equals 300% divided by 5 years equals 60% of total investment.

The percent of Total Investment to use for Average Investment for 5, 6, 8, 9, 10, and 12 year periods are as follows:

No. Years Depreciation	Percent Average Investment per Year
5	60%
6	58.33%
8	56.25%

9	55.56%
10	55%
12	54.17%

Therefore, the percentage of Total Investment per year and per hour to use for interest, insurance, taxes, and storage, based on 20% of average investment for the groups considered here, is as follows:

Interest, Insurance, Taxes, Storage
Based on 20 percent of Average Investment per Year

Avg. Investment	Years	Hours	Percent of Total Investment Per Year	Per Hour
60%	5	10,000	12.000%	0.006000%
58.33%	6	12,000	11.666%	0.005833%
56.25%	8	16,000	11.250%	0.005625%
55.56%	9	18,000	11.112%	0.005556%
55%	10	20,000	11.000%	0.005500%
54.17%	12	24,000	10.834%	0.005417%

Fixed Costs, Repairs, Maintenance, and Supplies. These are difficult to estimate. The figures used are not based on actual records but are believed to be representative. In the case of shovels and hoes, this cost is based on 100% of the total investment spread over the life of the machine and includes repairs, replacement parts and repair labor for normal operation, and such items as ropes, dipper and bucket teeth, oil and grease for lubricating machinery, as well as seasonal overhaul. It does not include engine fuel or lubricating oil.

In the case of draglines and clamshells, 80% of the total investment spread over the economic life of the machine is a fair average cost of these items.

In the case of lifting cranes, 60% of the total investment spread over the economic life of the machinery may be used.

The owner of an excavator should anticipate three things in regard to repairs and maintenance. First, the average figures used presume proper maintenance. Without this, repair bills will greatly exceed the estimates given here. Second, it is assumed the equipment will be used within its specified rating. Third, these expenses are not uniform each year.

Maintenance is then further defined in two major categories. The first is normal maintenance as a daily operating expense, which includes regular servicing on the job, such as fuel, changing oil, filters, greasing, brakes and hydraulic fluid levels, minor tuneups and the like.

The second category is defined as major maintenance, which requires that the equipment be idle for an extended period while repairs are made in the shop. An example of major maintenance would be the undercarriage of a dozer.

Provision should be made for a periodic general overhaul, and it should be expected that both the amount of repairs required and the losses caused by shutdowns will increase as the equipment becomes older.

Repairs, Maintenance, and Supplies, Including Labor Associated With Them

Shovels and Hoes

			Percent Of Total Investment	
Size	Years	Hours	Per Year	Per Hour
3/8 3/4 c.y. (.28-.57 m3)	5	10,000	20.00%	0.01000%
1 1-1/2 c.y. (.76-1.15 m3)	6	12,000	16.67%	0.00833%
2 3-1/2 c.y. (1.53-2.68 m3)	8	16,000	12.50%	0.00625%
4-1/4 c.y. (3.25 m3) or more	10	20,000	10.00%	0.00500%

Based on 100% of total investment spread over life of machine.

For example, assume a 3/4-c.y. (0.60 m^3) shovel cost $125,000.00. Repairs, maintenance, and supplies equal $125,000.00 x .0001 = $12.50 per hr.

Draglines and Clamshells

			Percent Of Total Investment	
Cu. Yds.	Years	Hours	Per Year	Per Hour
3/8 3/4 c.y. (.28-.57 m3)	5	10,000	16.00%	0.00800%
1 1-1/2 (.76-1.15 m3)	9	18,000	8.89%	0.00445%
2 3-1/2 (1.53-2.68 m3)	12	24,000	6.66%	0.00333%

Based on 80% of Total Investment Spread over Life of Machine.

Lifting Cranes

			Percent Of Total Investment	
Tons	Years	Hours	Per Year	Per Hour
2-1/2 5	5	10,000	12%	.006%
10 15	9	18,000	6.67%	.00333%
20 and over	12	24,000	5%	.0025%

Based on 60% of Total Investment Spread over Life of Machine.

Operating Costs, Engine Fuel, and Lubricating Oil. A formula for estimating the approximate amount of diesel fuel consumption for equipment of this type is as follows:

$$\frac{\text{BHP x Factor x lbs. fuel per HP hr.}}{\text{Weight of fuel per gallon (liter)}}$$

= Gallons (Liters) per Hour, where

BHP = Brake HP of engine or rated HP
Factor = Factor for this use 50 to 60%
Diesel = 0.5 lbs. per brake horsepower hour.
Diesel = 7.3 lbs. per gallon (U.S.)

From this formula we obtain an approximate diesel fuel consumption of 0.034 to 0.041 gals. (0.13-0.15 liters) per horsepower hour (based on 50% to 60% factor respectively), and suggest using an average of about 0.040 gal. per horsepower hour.

Shovels normally will consume a greater amount of fuel than the other types of machines considered here. Therefore the larger consumption rate indicated should be used for estimating fuel for shovels and the smaller rate for draglines and clamshells. Machines used for lifting crane service only usually operate intermittently and fuel consumption is difficult to estimate.

Example: A 100-horsepower engine in shovel service is estimated to consume per hour: 100 x 0.040 = 4.0 gals. (15 liters) of diesel fuel per hr.

Lubricating oil is considered with fuel, because it varies with the size and type of engine. It usually includes a complete change every 100 hours plus make-up oil between changes. Allow 15% of fuel costs.

Labor Operating Costs. The labor rates, as well as the number in the operating crew, vary in different parts of the country and on different jobs. The contractor must estimate this cost. Costs related to crew costs, besides rates of pay, are employer contributions for Federal Insurance Contribution Act, Workmen's Compensation Insurance,. Unemployment Compensation, Overtime, Paid Holidays, and Contractor's Contributions to Union Welfare and Pension Funds.

Power Shovel Yardages. To estimate yardage production on a job is a real problem. If all conditions were the same on all jobs, it would be a simple matter, but jobs are as different as night and day. There are many factors which must be considered, many of which can be learned only through experience. The type of material, the depth of cut for maximum effect, delays in operation, a 90° swing for the shovel. All affect the output.

The following table gives an approximate idea of the difference in maximum output possible, subject to conditions such as those listed above.

Hourly Shovel Output in Cubic Yards

Class of Material	Shovel Capacity 3/8	1/2	3/4	1	1-1/4	1-1/2	1-3/4	2	2-1/2
Moist Loam, Light Sandy Soil	85	115	165	205	250	285	320	355	405
Sand and Gravel	80	110	155	200	230	270	300	330	390
Common Earth	70	95	135	175	210	240	270	300	350
Clay, Hard and Tough	50	75	110	145	180	210	235	265	310
Rock, Well Blasted	40	60	95	125	155	180	205	230	275
Common Earth, with Rocks and Roots	30	50	80	105	130	155	180	200	245
Clay, Wet and Sticky	25	40	70	95	120	145	165	185	230
Rock, Poorly Blasted	15	25	50	75	95	115	140	160	195

Hourly Shovel Output in Cubic Meters

Class of Material	Shovel Capacity 0.3	0.4	0.6	0.8	1.0	1.1	1.3	1.5	1.9
Moist Loam, Light Sandy Soil	65	88	126	157	191	218	245	271	310
Sand and Gravel	61	84	119	153	176	206	230	252	298
Common Earth	54	73	103	134	160	183	206	230	268
Clay, Hard and Tough	38	57	84	111	138	161	180	203	237
Rock, Well Blasted	31	46	73	96	119	138	157	176	210
Common Earth, with Rocks and Roots	23	38	61	80	99	119	138	153	187
Clay, Wet and Sticky	19	31	54	73	92	111	126	141	176
Rock, Poorly Blasted	11	19	38	57	73	88	107	122	149

The quantities in the above table are based on bank measure, which means cubic yards removed from the bank rather than cubic yards (cubic meters) in the hauling unit. There is a big difference between a yard of dirt in the bank and a yard of dirt in the truck. This is because of the swell of the material or its increase in volume due to voids when it is dug or loosened. For instance, common excavation will swell from 10% to 30%. Another condition is that the machine is working in a depth of cut suitable for maximum digging efficiency. The optimum depth of cut for various sizes of shovel may be defined as that depth which produces the greatest output and at which the dipper comes up with a full load.

The output figures are based on continuous operations, 60 minutes per working hours, without any delays for adjustments, lubrication, operator stopping for any reason, etc.

The figures are based on each dipper-full of material being swung through an arc of 90° before dumping. This is important, because a swing of either a lesser number or greater number of degrees than 90° will either save or consume time and affect output capacity.

Tables are based on all materials being loaded into hauling units, with the further understanding that these hauling units are properly sized to shovel capacity and are provided in sufficient quantities to take away all the material that the shovel can dig.

While these figures represent a very comprehensive job and as realistic a picture as can be presented on this involved subject, a word of caution is in order. These figures are general only and should not be considered as guaranteed outputs, or used by anyone as a basis for figuring and bidding jobs.

How Degrees of Swing and Depth of Cut Affect Shovel Yardage Output. The quantities in the above table are based on the optimum depth of cut and a swing of 90° was specified.

Because variations in either of these conditions will have considerable effect on the yardage output, the following chart shows what happens when swing and depth of cut vary from the conditions on which the previous basic hourly yardages were established.

Table Giving Effect of Depth of Cut and Angle of Swing on Power Shovel Output

Depth of Cut in % of Optimum, l.f. (m)	45°	60°	75°	90°	120°	150°	180°
40' (12.2m)	0.93	0.89	0.85	0.80	0.72	0.65	0.59
60' (18.3m)	1.10	1.03	0.96	0.91	0.81	0.73	0.66
80' (24.4m)	1.22	1.12	1.04	0.98	0.86	0.77	0.69
100' (30.5m)	1.26	1.16	1.07	1.00	0.88	0.79	0.71
120' (36.6m)	1.20	1.11	1.03	0.97	0.86	0.77	0.70
140' (42.7m)	1.12	1.04	0.97	0.91	0.81	0.73	0.66
160' (48.8m)	1.03	0.96	0.90	0.85	0.75	0.67	0.62

Dragline Yardages. As in the case of power shovels and hoes, dragline yardage production is affected by the type of material to be excavated, the depth of cut, the swing before unloading, the type of unloading (unloaded into hauling units, cast onto spoil banks, etc.), the degree of continuity in the operation, etc.

The following table gives an approximate idea of the difference in maximum production possible subject to conditions listed:

Hourly Short Boom Dragline Output in Cubic Yards

Bucket Capacity	3/8	1/2	3/4	1	1-1/4	1-1/2	1-3/4	2	2-1/2
Class of Material									
Moist Loam, Light Sandy Clay	70	95	130	160	195	220	245	265	305
Sand and Gravel	65	90	125	155	185	210	235	255	295
Common Earth	55	75	105	135	165	190	210	230	265
Clay, Hard and Tough	35	55	90	110	135	160	180	195	230
Clay, Wet and Sticky	20	30	55	75	95	110	130	145	175

Hourly Short Boom Dragline Output in Cubic Meters

Bucket Capacity	.28	.38	.57	.76	.96	1.15	1.34	1.53	1.91
Class of Material									
Moist Loam, Light Sandy Clay	54	73	99	122	149	168	187	203	233
Sand and Gravel	50	69	96	119	141	161	180	195	225
Common Earth	42	57	80	103	126	145	160	175	203
Clay, Hard and Tough	27	42	69	84	103	122	138	150	175
Clay, Wet and Sticky	15	23	42	57	73	84	99	110	134

The dragline is working in the optimum depth of cut for maximum efficiency.

The dragline is working a full 60 minutes each hour no delays.

The dragline is making a 90° swing before unloading.

The bucket loads are being dumped into "properly sized" hauling units.

The proper type bucket is being used for the job.

The dragline is being used within the working radius recommended by the manufacturer for machine stability.

How Degrees of Swing and Depth of Cut Affect Dragline Yardage Output. The following table gives the effect of depth of cut and angle of swing on dragline yardage production. Variations in degrees of swing, in particular, have a marked effect on production and this is important to keep in mind when laying out a job as the shorter the swing the more the yardage.

Table Giving Effect of Depth of Cut (in feet and meters)
and Angle of Swing on Dragline Output

Depth of Cut in % of Optimum	Angle of Swing in Degrees 30	45	60	75	90	120	150	180
20' (6.1m)	1.06	0.99	0.94	0.90	0.87	0.81	0.75	0.70
40' (12.2m)	1.17	1.08	1.02	0.97	0.93	0.85	0.78	0.72
60' (18.3m)	1.24	1.13	1.06	1.01	0.97	0.88	0.80	0.74
80' (24.4m)	1.29	1.17	1.09	1.04	0.99	0.90	0.82	0.76
100' (30.5 m)	1.32	1.19	1.11	1.05	1.00	0.91	0.83	0.77
120' (36.6m)	1.29	1.17	1.09	1.03	0.98	0.90	0.82	0.76
140' (42.7m)	1.25	1.14	1.06	1.00	0.96	0.88	0.81	0.75
160' (48.8m)	1.20	1.10	1.02	0.97	0.93	0.85	0.79	0.73
180' (54.9m)	1.15	1.05	0.98	0.94	0.90	0.82	0.76	0.71
200' (61.0m)	1.10	1.00	0.94	0.90	0.87	0.79	0.73	0.69

Clamshell Production. The clamshell excavator is not to be considered a high production machine but rather a machine to be used where the work is beyond the scope of other types of equipment. For example, a condition which usually requires a clamshell is where digging is vertical or practically straight down as in digging pier holes or shafts. Digging in trenches that are sheathed and cross-braced generally calls for a clamshell, because the vertical action of the bucket enables it to be worked through the cross-bracing. Jobs requiring accurate dumping or disposal of materials are usually clamshell jobs. Also, for high dumping jobs, whether it be charging a bin, building a stockpile, or wherever the material must be dumped well above the machine level, the clamshell is well adapted. In general, the clamshell can operate vertically and dig or spot dump below, at, or above the level of the machine.

The clamshell is only effective where the materials to be handled are relatively soft or loose.

Conditions are so variable on clamshell operation that a table showing typical production has little value.

However, in an effort to establish some point to work from, the following table has been prepared showing maximum production to be expected from clamshell excavators operating under the following conditions:

The clamshell is engaged in open digging such as a basement or large footing, with the permissible cut at least a full bucket depth.

1. The depth of the excavation is not more than 10'-0" (3 m).

2. The quantities are in terms of bank measure.

3. There is no wasted time, 60 minutes of digging each hour.

4. The clamshell is making a 90° swing before unloading.

5. The bucket loads are being dumped into "properly sized" hauling units.

6. The clamshell is being used within the working radius recommended by the manufacturer for machine stability.

Hourly Short Boom Clamshell Handling Capacity, Cubic Yards

Bucket Capacity	3/8	1/2	3/4	1	1-1/4	1-1/2	1-3/4	2	2-1/2
Class of Material									
Moist Loam or Sandy Clay	50	65	95	120	140	155	170	190	225
Sand and Gravel	45	60	85	110	130	140	160	175	205
Common Earth	40	55	70	95	115	125	145	160	185

Hourly Short Boom Clamshell Handling Capacity, Cubic Meters

Bucket Capacity	0.28	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.91
Class of Material									
Moist Loam or Sandy Clay	38	50	73	92	107	119	130	145	172
Sand and Gravel	34	45	65	84	99	107	122	134	157
Common Earth	30	42	53	73	88	96	110	122	141

It must be thoroughly understood that the above production is based on the most ideal job and management conditions.

How Degrees of Swing Affect Clamshell Yardage. The output of a clamshell operating at a steady pace is affected by the swing before unloading in the same manner as a dragline. The following table gives the effect of angle of swing on clamshell yardage production.

Angle of Swing in Degrees

30°	45°	60°	75°	90°	120°	150°	180°
1.32	1.19	1.11	1.05	1.00	0.91	0.83	0.77

Job and Management Factors. Ideal conditions seldom, if ever, exist in the field, and it is necessary to rationalize these figures by some other factor to compensate for the fact that actual job conditions differ widely from the perfect conditions assumed so far.

There are two sets of factors on every job that have a great deal to do with the output of equipment on the job. They are the job factor and the management factor.

Job factors are the physical conditions pertaining to a specific job that affect the production rate, other than the class of material to be handled. These may be divided into three general headings:

1. topography and the dimensions of the work, which include the depth of cut and whether the work will require much moving within the cut or from one cut to another;

2. surface and weather conditions, which include in some cases the difference between summer and winter work, and also the question of drainage of either surface or underground water;

3. specification requirements that control the manner in which the work must be handled, or indicate the sequence of various operations, and which also show the amount of bank sloping or cutting close to finished line and grade that is required.

The above conditions are all inherent in the job itself and can be taken into account by the contractor in making up the bid.

Another group of factors which affect output are the management factors. These cover conditions which pertain to the efficiency of the operation and thus affect output. These are grouped under the head of the management factor because, in general, they are made up of items which management can determine and control. These include:

1. selection, training, and direction of personnel; the quantities given in the tables indicate what can be reasonably expected by an experienced operator who is willing to work; the availability of trained workers and the incentive to produce must be considered;

2. selection, care, and repair of equipment; the quality of the inspection and preventive maintenance program can have much to do with the lost time on the job;

3. planning, laying out the job, supervising, and coordinating the operations is a very important factor in increasing efficiency; providing the right number and size of hauling units is one of the first things to show its effect.

Foremanship and supervision are important. When everything is working smoothly, there is added incentive for high production rates.

Because both job and management factors must be considered jointly, that is, the output yardages must be modified by both a job and a management factor, the following table consolidates these factors.

To estimate the yardage, select the proper combined job and management factor from the following table. First, select a job factor classification of excellent, good, fair or poor, whichever applies to your job conditions and follow straight across the management factor classification of excellent, good, fair or poor, whichever applies to the management conditions. The resulting figure is the combination job management factor by which the yardage figures from the basic output tables (as modified by the conversion factors for depth of cut and swing) must be multiplied to give the yardage factor that can reasonably be expected under the job management conditions that will exist on the job.

Usually, pit and quarry and heavy construction jobs will fall into groups 1, 2, or 3, whereas highway grading will usually fall into groups 2, 3, or 4 because of the variations in cuts, required machine travel, close cuts, etc.

Combination Job and Management Factors

	Management Factors			
	1	2	3	4
Job Factors	Excellent	Good	Fair	Poor
1. Excellent	0.84	0.81	0.76	0.70
2. Good	0.78	0.75	0.71	0.65
3. Fair	0.72	0.69	0.65	0.60
4. Poor	0.63	0.61	0.57	0.52

Power Shovel Excavating

Modern shovels, powered by diesel engines, have tremendous capacity when conditions permit working without interruptions.

The cost of power shovel excavating will vary with the size of the job, size of the shovel, and the speed with which the trucks are handled in and out of the hole. Seldom can the shovel work to capacity on building work, due to the congestion of trucks waiting to get in or out of the hole or due to trucks being delayed at the dump.

The size of the job has considerable bearing on the costs, as it costs just as much to get the shovel to the job and remove it at completion for 1,000 cu. yds. (765 cu.m) as for a 10,000 cu. yd. (7645 cu.m) job.

Where it is possible to use a 3/4-cu. yd. (0.60-m) shovel to capacity (figuring a 100% bucket load each cycle), it should excavate 135 cu. yds. (103 cu.m) an hr. but the bucket is not always filled to capacity and there are delays in loading, moving shovel from place to place, cleaning up, bad weather, etc., so the average on building work will probably run 50% to 60% of the rated capacity of the shovel.

Basis for Computing Daily Output of Diesel Powered Shovel. The following method is used in figuring the output of a power shovel in basement excavation, based on a 1 cu. yd. (0.76 cu.m) shovel:

Bucket capacity	1 cu. yd. (0.76 cu.m)
Bucket efficiency, average material	90%
Load carried	0.9 cu. yds. (0.68 cu.m)
Average operating cycle	20 Seconds
Cycles per hour	180 Cycles
Cu. Yds. per hour, operating 100% time	162 cu. yds. (124 cu.m)
Operating efficiency in basement excavation due to haulage service, machine delays and cleanup work, approximately	50 to 60%
Average output per 8-hr. day	640-760 cu.yds. (490-580 cu.m)
Operating efficiency on heavy construction, roads, dams, open cut excavation, etc., including machine delays and cleanup work, approximately 66.67%. Average output per 8-hr. day	864 cu.yds. (660 cu.m)

Dragline Excavating

The cost of dragline excavating will vary in the same manner as shovel excavating, according to the size of the job, size of the machine, and the capacity and speed of the hauling units. But the hauling hazards are reduced substantially by the trucks not having to be loaded in the hole, eliminating the necessity of trucking up a ramp.

As may be determined by comparing the basic output tables for shovels and draglines, the dragline has about 75% to 80% of the basic output capacity of shovels. However, the dragline definitely has a place in excavating for construction work by virtue of its generous digging reach, its ability to dig under extremely wet conditions (it can stand on the top on dry, firm footing), and the easier haul with no ramps to climb, all conditions that under certain circumstances would make shovel digging very expensive if not totally impossible.

In excavating for building construction, the dragline is affected by job and management factors the same as shovels and the same basis for computing daily output may be used as follows.

Basis for Computing Daily Output of Dragline Excavator. The following is based on a dragline having a 1 cu. yd. (0.76 cu.m) bucket.

Bucket capacity	1 cu. yd. (0.76 cu.m)
Bucket efficiency, average material	90%
Load carried	0.9 cu. yd. (0.68 cu. m)
Average operating cycle	24 Seconds
Cycles per hour	150 Cycles
Cu. Yds. Per hour, operating 100% time	135 cu. yds. (102 cu.m)
Operating efficiency in basement excavation	

due to machine delays, traffic delays to hauling units and clean up work, approximately........ 50 to 60%
Average output per 8-hr. day........ 540-650 cu. yds. (413-497 cu.m)
Operating efficiency on heavy construction, roads, dams, open cut excavation, etc., including machine delays and clean up work, approximately........ 66.67%
Average output per 8-hr. day........ 720 cu. yds. (550 cu.m)

Backhoe Excavating

The backhoe is a cross between the dragline and the shovel, which is why it is the equipment of choice today. It incorporates some of the characteristics of each and overcomes some of the limitations of each. The backhoe is primarily a unit for digging below machine level, but it will dig harder material than the clamshell or dragline, because the weight of the boom itself may be used to force the dipper into the material. It is, however, limited in digging by the length of the boom and stick. The backhoe dipper can be controlled more accurately than the dragline bucket and is better suited to close-limit work.

In building construction the backhoe is used to dig trenches, footings, and basements. On small residence basements, it offers many advantages. It digs straight, vertical side walls (in soil which will stand); it cuts a level floor; it trims corners neatly and squarely; it can dig sewer and waterline trenches; it always works from the top on dry, safe ground; and it reduces hand trim to a minimum.

In general, the process of digging a basement with a backhoe is to dig a trench around the four sides of the basement and scoop out the center as you go.

On small work it is necessary to have low-cost, simple and easy means of moving the backhoe from job to job. This is best done by using a single-purpose trailer which can be loaded or unloaded in 15 to 20 minutes. The cost of moving the backhoe from job to job will vary with the distance between jobs.

On time studies made on several small basement jobs, where the basements contained from 275 to 350 cu. yds. (210-268 cu.m) of excavation, a backhoe excavator equipped with a 3/4-cu. yd. (0.57-cu.m) bucket averaged from 66 to 88 cu. yds. (50-67 cu.m) per hour.

An example of the cost of excavating a small basement containing approximately 350 cu. yds. (268 cu.m) of excavation, with the soil placed around the excavation, is as follows:

	Hours	Rate	Total	Rate	Total
Move-In Charge........		$....	$....	$110.00	$110.00
Excavating					
Hoe operator........	5.0	....	....	28.55	142.75

Labor, clean-up	5.0	....	....	21.04	105.20
Hoe charge	5.0	....	....	38.00	190.00
Total Direct Cost			$....		$547.95
Cost per cu. yd.			....		1.57
Cost per cu. m			....		2.04

The above costs do not include removal of excavated earth from site or backfilling.

Data on Diesel Power Shovel Costs and Operation

	Size of Shovel (in Cu. Yds.)						
Description	3/4	1	1-1/2	2	3-1/4	4-1/4	5-1/2
Cu. Yds. per Hr. Based on 100% Time	135	180	270	360	585	765	950
Cu. Yds. per Hr. Based on 100% Time and 90% Dipper Efficiency	121	162	243	324	526	688	855
Output per Hr. Based on 66.67% Efficiency, Cu. Yds.	90	120	180	240	390	510	633
Output per Hr. Based on 50% Efficiency, Cu. Yds.	68	90	135	180	293	383	475
Output per 8-Hr. Day, Based on 66.67% Efficiency, Cu. Yds.	720	960	1440	1920	3120	4080	5064
Output per 8-Hr. Day, Based on 50% Efficiency, Cu. Yds.	544	720	1080	1440	2344	3064	3800
Average Cost Diesel Shovel, including Freight and Unloading	$91,000	96,000	146,000	310,000	547,000	672,000	955,000
Depreciation, Percent per Year	20	16.66	16.66	16.66	12.50	10	10
Depreciation per Hr. Based on 2,000 Hrs. per Year	$9.10	$8.00	$12.16	$25.82	$34.19	$33.60	$47.75
Interest, Taxes, Insurance, 20% per Year of 2,000 Hrs.	$5.50	$5.80	$8.80	$18.60	$32.80	$33.60	$47.80
Hourly Consumption of Fuel, Approximate Gals. per Hour	4.5	4.5	5.2	6.4	12.0	15.5	18.0
Fuel Cost per Hour*	$6.75	$6.75	$7.80	$9.60	$18.00	$23.25	$27.00
Engine Lub. Oil Cost, 15% of Fuel	$1.01	$1.01	$1.17	$1.44	$2.70	$3.48	$4.05
Cost per Hr., Repairs, Maintenance and Supplies, including Rope, Grease	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00
Total Hourly Cost, Not Including Labor, Supervision, Compensation, Unemployment, Soc. Sec. etc.	$29.56	$30.36	$37.93	$63.46	$95.69	$101.93	$134.60

*Fuel costs based on diesel fuel at $1.50 per gal.

(metric)

Description	Size of Shovel (in Cubic Meters) 0.60	0.80	1.15	1.50	2.50	3.25	4.20
Cu. M per Hour Based on 100% Time	103	138	207	275	447	585	726
Cu. M per Hour Based on 100% Time and 90% Dipper Efficiency	93	124	186	247	402	527	653
Output per Hour Based on 66.67% Efficiency, Cu. Meters	68	92	138	183	298	390	484
Output per Hour Based on 50% Efficiency, Cu. Meters	52	69	104	137	224	293	363
Output per 8-Hour Day, Based on 66.67% Efficiency, Cu. M	544	736	1104	1464	2384	3120	3872
Output per 8-Hour Day, Based on 50% Efficiency, Cu. M	416	538	832	1096	1792	2344	2904
Average Cost Diesel Shovel, Including Freight and Unloading	91,000	96,000	146,000	310,000	547,000	672,000	955,000
Depreciation, Percent per Year	20	16.66	16.66	16.66	12.50	10	10
Depreciation per Hour Based on 2,000 Hours per Year	$9.00	$8.00	$12.00	$26.00	$34.00	$34.00	$48.00
Interest, Taxes, Insurance, 20% per Year of 2,000 Hours	$5.50	$5.80	$8.80	$18.60	$32.80	$33.60	$47.80
Hourly Consumption of Fuel, Approximate Liters per Hour	17.00	17.00	20.00	24.00	45.00	60.00	68.00
Fuel Cost per Hour*	$6.80	$6.80	$8.00	$9.60	$18.00	$24.00	$27.20
Engine Lub. Oil Cost, 15% of Fuel	$1.02	$1.02	$1.20	$1.44	$2.70	$3.60	$4.08
Cost per Hour, Repairs, Maintenance and Supplies, Including Rope, Grease,etc	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00
Total Hourly Cost, Not Including Labor, Supervision, Compensation, Unemployment, Soc. Sec. etc.	$30.32	$29.62	$38.00	$63.64	$95.50	$103.20	$135.08

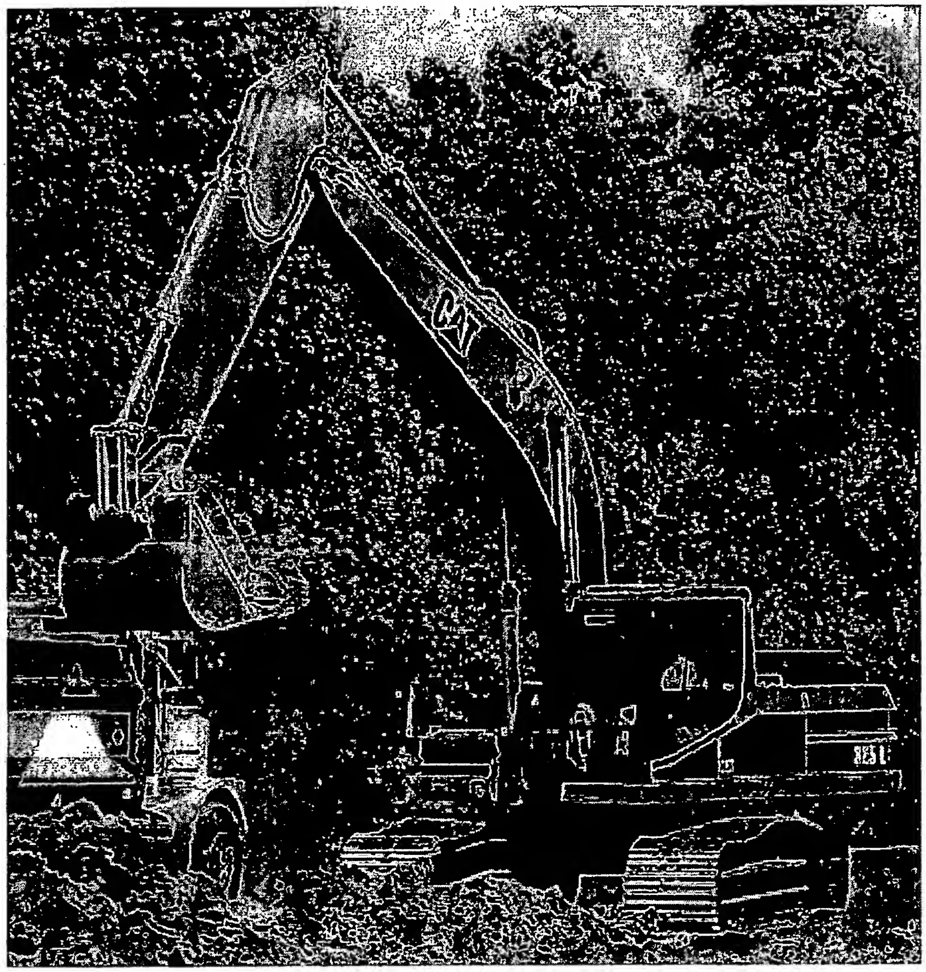
*Fuel costs based on diesel fuel at $1.50 per gal.

Below is a digging plan for excavating small basements using a hoe. The order of the letters indicates the order in which the sections are removed. The arrows indicate the direction the hoe travels in taking out each section.

Truck and trailer time to deliver the hoe and removing same at completion of job will vary with length of haul.

In medium to large work and at moderate depths, hoe production can approach that of shovels. Output falls off considerably, however, at greater depths.

For the smaller machines, the size hoe is usually chosen for the width trench it will cut, but for the larger sizes, the capacity of the machine is chosen on a production basis.

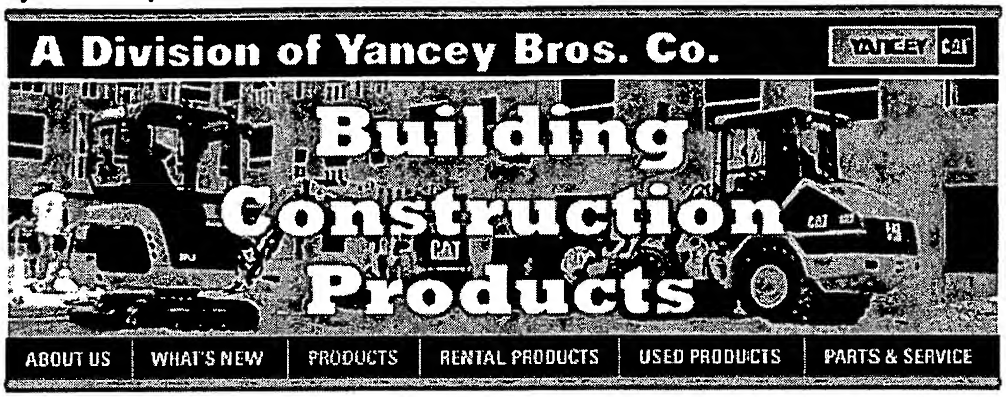


Backhoe Excavating Trench
Courtesy Caterpillar, Inc.

Data on typical backhoe bucket dimensions and weight is given in the following table.

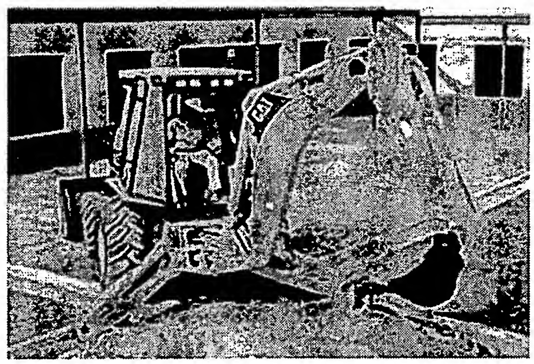
Dipper Capacity, cu. yd.	cu.m	Bucket Outside Width in inches	mm	Total Width Added for 2 Side Cutters inches	mm	Weight in Lbs.	Kg
3/8	0.28	20-24	500-600	4-6	100-150	850	386
1/2	0.38	24-28	600-700	4-9	100-225	950	430
3/4	0.57	28-39	700-975	4-9	100-225	1400	635
1	0.76	33-45	825-1125	4-9	100-225	1700	771
1-1/4	0.95	39-45	975-1125	4-9	100-225	2000	907
1-1/2	1.15	39-45	975-1125	4-9	100-225	2,300	1043

www.yanceybcp.com/backhoe.htm



Backhoe Loaders

Caterpillar's New Line of High Performance Backhoe Loaders



420D and 430D Backhoe Loaders
The new Caterpillar® 420D and 430D are the high performance machines in the new D-Series Backhoe Loader line. The 420D and 430D apply new technology for increased reliability and durability, ease of operation and superior performance in a wide range of applications for owner/operators, building construction contractors, large contractors and sewer and water contractors. The new models replace the Caterpillar 416C, 426C, and 436C Backhoe Loaders.

Previous Cat backhoe loader models introduced industry-leading features with the excavator style boom, load sensing hydraulics, and the IT loader. With the 420D and 430D models, Caterpillar continues a tradition of firsts for backhoe loaders in providing standard pilot operated joystick controls for the backhoe. Similar to hydraulic excavator controls, the system is easy to learn and use, allowing smooth, efficient operation.

The 420D has 85 net horsepower (63 kW) and a backhoe digging depth of 14 feet 5 inches (4.39 meters) when equipped with a standard stick. The 430D has 94 net horsepower (70 kW) and a backhoe digging depth of 15 feet 3 inches (4.64 meters) when equipped with a standard stick. An extendible stick pushes the 420D digging depth to 18 feet 1 inch (5.51 meters) and the 430D digging depth to 19 feet 11 inches (6.08 meters).

Both the 420D and 430D machines are available in integrated toolcarrier (IT) configurations for applications that benefit from a parallel-lift loader linkage and the versatility of quick work tool changes through the use of the hydraulic quick coupler. Such applications include the use of pallet forks, material handling arms, brooms, and a variety of buckets.

The 420D / 420D IT and the 430D / 430D IT feature many innovations that increase backhoe loader performance and productivity:

- Pilot operated hydraulic backhoe and IT loader controls help ensure smooth, precise operation and reduce operator effort. The backhoe uses excavator-style joystick controls, and an optional pattern changer valve to select the control pattern.
- The 205-degree rotation of the backhoe bucket linkage makes it easier to dig vertical walls and to clamp material for truck loading. Rotation is 40 degrees more than the C-Series backhoes. The backhoe buckets now feature a single pin position and all former models' buckets and Cat work tools can be used on the D-Series. In addition, the bucket link has an integrated lifting eye.
- New Caterpillar bucket teeth provide longer wear life and feature the exclusive Cat Diagonal Retention System for easy tooth replacement.

- High digging forces and superior lifting capabilities boost production. Backhoe bucket breakout force for both models is more than 14,700 lb (65.4 kN). Backhoe stick lift capability is 6,250 pounds (2830 kg) for the 420D and 6,610 pounds (3000 kg) for the 430D.
- The optional quick coupler for the backhoe allows quick changes of work tools for additional versatility and flexibility in applications.
- The optional Auto-Up stabilizer control speeds place changes when using the backhoe.
- The Auto-Shift transmission option operates as an automatic transmission with a manual override. A kickdown switch on the loader lever equips the machine to perform much like a wheel loader.
- A new single lever pilot-operated joystick loader control is standard on all IT machines. This provides smooth, modulated control for three loader functions.
- A roomier, more comfortable cab allows room to stretch for less operator fatigue and improved productivity. The cab provides excellent viewing to the work areas.

The new 420D and 430D backhoe loaders are available with a standard cab complete with an air suspension seat or a deluxe cab that includes additional seat features, added instrumentation, and an Auto-Up mode for the stabilizers. The operator station in D-Series backhoe loaders includes white-face gauges, a new hand throttle, new boom lock position and new pilot-operated stabilizer controls.

The 420D and 430D rely on proven Cat powertrains and load-sensing hydraulic systems for fast response and efficient fuel management. Both new backhoe loaders use the Cat 3054T turbocharged, direct-injection, four-cylinder diesel engine. Displacement is 4.0 liters. The engine offers superior lug performance largely due to the responsive fuel injection system. The standard Power-Shuttle transmission provides four speeds forward and four reverse. Full synchromesh in all gears permits on-the-go shifting, and the forward/reverse electric power shuttle provides instant direction changes through power hydraulic clutches. The Auto-Shift option automatically shifts between second gear and the highest selected gear for ease of operation. Auto-Shift has five forward and three reverse speeds, with a transmission kickdown switch on the loader lever.

The new backhoe loaders offer a choice of standard two-wheel drive or all-wheel drive, which can be engaged on-the-go, under load by a switch on the front console. The fully enclosed, oil-immersed hydraulic, multiple disc brakes work with a three-position brake mode switch. The operator can select 2-wheel drive and braking, 2-wheel drive and all-wheel braking, or all-wheel drive and braking. The options allow better holding and control on slopes and in poor underfoot conditions.

The Cat variable-flow, closed-center, load-sensing hydraulic system adjusts flow and pressure to meet the work demand with increased pressure of 3300 psi (22754 kPa). The hydraulic system is tuned to work efficiently with the engine, and it provides full hydraulic force to the work tool at any engine speed. The system reduces demands on the operator, cuts fuel consumption, reduces engine wear and allows quieter operation.

The Caterpillar 420D and 430D backhoe loaders offer many advanced features and many options to make operation easier and more productive.

416D Backhoe Loader

The new Caterpillar 416D Backhoe Loader is designed and built to provide proven durability, reliability and quality at a very competitive purchase price. The 74 net horsepower (55-kW) 416D offers 14 feet 5 inches (4.39 meters) of backhoe digging depth with a standard stick and 18 feet 1 inches (5.51 meters) of digging depth with an extendible stick. The 416D is well suited for rental fleets, utilities and governmental applications.

The 416D relies on proven Caterpillar backhoe loader designs while offering several features not found on C-Series backhoe loaders:

- The 205-degree rotation of the backhoe bucket linkage makes it easier to dig vertical walls and to clamp material for truck loading. Rotation is 40 degrees more

than the C-Series backhoes. The backhoe buckets now feature a single pin position and all former models' buckets and Cat work tools can be used on the D-Series. In addition, the bucket link has an integrated lifting eye.

- Low-effort pilot hydraulic stabilizer controls provide convenient modulated control.
- The stabilizer controls and boom lock location have been repositioned for easier access.
- More comfortable operator station enhances operator efficiency.

Other standard features include:

- Lower effort backhoe and loader controls which reduce operator fatigue.
- Load-sensing hydraulics providing power when and where it is needed without wasted fuel or wear.
- New Caterpillar bucket teeth providing longer wear life and feature the exclusive Cat Diagonal Retention System for easy tooth replacement.

The 416D retains the excavator-style boom that provides additional clearance over obstacles while digging or truck loading. The narrow boom allows better sight lines to the excavator bucket, too.

Basic specifications for Caterpillar Backhoe Loaders

Center-Pivot

Model	Engine	Engine (Optional)	Gross Power (Standard)
416C	Cat 3054T Diesel		59 kW / 78 hp
416D	Cat 3054B Diesel	Cat 3054T Turbocharged Diesel	58 kW / 77 hp
420D	Cat 3054T Diesel		66 kW / 88 hp
426C	Cat 3054T Diesel		63 kW / 84 hp
430D	Cat 3054T Diesel		73 kW / 98 hp
436C	Cat 3054T Diesel		66 kW / 89 hp
446B	Cat 3114T Diesel		82 kW / 110 hp

Center-Pivot with Integrated Toolcarrier

Model	Engine	Engine (Optional)	Gross Power (Standard)
416C IT	Cat 3054T Diesel		59 kW / 78 hp
426C IT	Cat 3054T Diesel		63 kW / 84 hp
430D IT	Cat 3054T Diesel		73 kW / 98 hp
436C	Cat 3054T Diesel		66 kW / 89 hp

BCP CORPORATE OFFICES
300 Lee Industrial Blvd. ~ Austell, GA 30168
Toll Free (877) 292-6239 ~ (678) 718-6500 ~ Fax (678) 718-6530